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S HOWING THE CONTENTS OF EXCAVATIONS, AREA OF SLOPES, &c. By GEORGE P. BIDDER, CIVIL ENGINEER. 50 50 122-2 49 49 40 The red figures represent the contents, in solid yards, of any of the intersecting columns, and are intended to be applied to the central part of any cutting, exclusive of the slopes. The other ligures she are the entent of 1 to 1 slopes whose heights are shown, as before, by EXPLANATION 48 17 numbers of the intersecting commus. In reading off the contents from the table, it must be entered by \$\xi\$ irst finding the greatest height in the bottom line, and the less height in the left hand vertical column, and then referring to the intersection 16 of the vertical and horizontal columns. Thus, at the intersection of the columns 20 and 10, we have 36 The method of application is obvious: thus, let it be required to a secretain the content of the cutting in the diagram, Fig. 1, whose cross section is shown in Fig. 2. 5520 5403 5287 5173 5061 4950 1161 1149 1137 1125 11112 1100 45 5407 5291 5176 5062 49.1 48.1 47.5 114.9 113.7 112.5 111.2 110.8 103.8 107.6 44 108:8 107:6 43 4733 4625 4520 107:6 106:3 105:1 5296 5100 5066 4953 4842 113-7 112-5 111-2 110-0 108-8 42 0 0 0 0 0 0 1137 112-5 111-2 110-0 1088 107-6 106-3 105-1 42 5186 5871 4957 4846 4736 4627 4521 4446 4512 112-5 111-2 110-0 108-8 107-6 106-3 105-1 103-9 102-7 At the intersection of the columns 5 and 0, are | 6:1 and 20, which insert as before; and 30 on to the ene | 1. Then multiply the sum of the quantities in a by 24, the width of the by 2, the slope being 2 to 1. The s | nm of these two products will be the required content. 10 4323 4417 4313 4210 4109 105:1 103:9 102:7 101:5 100:2 __ 41 40 3911 Then $(-220 \times 24) + (4726 \times 2) = 5280 + 9452 = 14732$ enbie yards, the total econtent required. Yds. Yds. 20 30.6 428 4970 4857 4746 4636 4527 1100 108:8 107:6 106:3 105:1 4420 4315 4212 4110 4810 103:9 109:7 101:5 100:2 99:0 -40 Should the heights exceed those Thus, when they fall between 50 and second by 2. When they fall between 150 and 200, first divide them by 3 before the table is entered, and afterwards must be first content in the table, the contents may be found by entering with one-half, or one-fourth, &c., of the measures. Thus, when they fall between 50 and entering the table with the quotients, multiply the first content in that case by 9, and the property of the propert 97·8 39 3014 3718 96·6 95·3 4319 4215 4112 4011 3912 102-7 101-5 100-2 99:0 97:3 4865 4753 4642 4533 4425 108:8 107:6 106:3 105:1 103:9 3014 3718 96 6 95 3 3719 3624 3538 95 3 94 1 30 2 39 1 61.1 1548 67-2 1854 4220 4116 4015 3914 3816 101.5 100.2 99.0 97.8 96.6 4762 4650 4540 4432 4325 107:6 106:3 105:1 103:9 102:7 _38 38 1 [10] | 42.8 | 454 [10] | 12.2 | 82 19:0 79.1 95·3 94·1 92·9 **37** 3625 3531 3438 3346 94·1 92·9 91·7 90·5 second by 3. When the properties of the second by 3. Then entering the table with 40 at the bottom and 28 at the side, the second by 3, the required contents are 25695 and 249:3. solid vards respectively. 3533 3439 3347 3257 3168 929 917 905 03 859 37 \ \\ 4660 \ \ 4549 \ \ 4440 \ \ 4332 \ \ 4226 \\ 106-3 \ \ 105-1 \ \ 103-9 \ \ 102-7 \ \ 101-5 4122 4020 3918 3819 3721 1002 09:0 97:8 98:6 95:3 220.0 4726 36 4560 4450 4341 4235 4130 4026 3924 3824 3725 3628 -36 If it be desirable, for the purpose of saving time, to divide the section into longer and uneque of proceeding:—Let it be required to ascertain the content of an excavation as shown in Fig. 3, and whose cross section is exhibited in Fig. 4. 3443 3350 3258 3169 3081 2994 917 905 893 880 868 856 34 35 35 \\ \begin{pmatrix} 4461 & 4352 & 4244 & 4138 & 4034 \\ 103.9 & 102.7 & 181.5 & 100.2 & 99.0 \end{pmatrix} 3932 3838 3731 3633 3537 978 966 953 941 929 Fig. 4. Fig. 3. 3354 3262 3171 3082 2995 90.5 89.3 800 868 85.6 2910 2026 04:3 53:1 33 34 34 1 4364 4256 4149 4044 3940 102.7 101.5 100.2 99.0 97.8 3839 3738 3640 3543 3448 96:6 95:3 94:1 92.9 91:7 33 14269 4161 4055 3951 3848 101.5 100.2 990 978 966 3267 3175 3086 2990 2911 89:3 88:0 868 83:6 81:3 2827 2744 2662 831 842 867 30 33 3747 3648 3550 3434 3360 95:3 94:1 92:9 91:7 90:5 A form according to the following may be used, where Col. No. 1 ind cates the length of each division in chains, Col. No. 2 the height at each end of every division, Col. No. 3 the content of the middle part of 1 ch. in length and 1 ft. in width, Col. No. 4 the content of the middle part of 2 ch. No. 3 the content of the middle part of 2 ch. No. 3 the content of the middle part of 3 ch. No. 5 the content of the slopes of 1 to 1, Col. No. 6 the content of slopes 1 to 1 for multiplied by the lengths of the divisions respectively). Col. No. 5 the content per chain of the cate of the slopes of 1 to 1, Col. No. 6 the content of slopes 1 to 1 for multiplied by the lengths of the divisions respectively). Then adding up Cols. Nos. 4 and 6, a former by 23, the width of the central part of the slopes 1 to 1, their sum will show of the said exercation. 23 fl 32 \ \\ \dagger{4175} \ \dagger{4068} \ \dagger{3963} \ \dagger{3860} \ \dagger{3758} \ \dagger{4062} \ \dagger{990} \ \dagger{97.8} \ \dagger{96} \ \dagger{95.3} \dagger{96} \dagger{95.3} 3658 3559 3462 3367 3273 944 929 917 905 893 3181 3091 3003 2915 2829 88*0 86*8 85*6 84*3 83*1 2745 2663 2582 2503 819 807 790 782 31 32 31 4083 3977 3873 3770 3669 2665 2584 2504 2426 2349 31 3570 3472 3376 3281 3188 99-9 91-7 90-5 89-3 88-0 2587 2506 2427 2350 2274 2200 20 30 30 } 3993 3888 3784 3682 3382 97-8 96-6 93-3 94-1 92-9 3403 3386 3291 3197 3105 91:7 90:5 89:3 88:0 86:8 3015 2926 2839 2753 2669 2510 2431 2352 2276 2201 2128 2056 78:2 77:0 75:8 74:6 73:3 72.1 70:9 20 29 3904 3800 3697 3596 3496 92-9 91-7 3399 3382 3208 3115 3024 90-5 80-3 88-0 86-8 85-6 28 | 3817 3713 3611 3511 3412 95 3 941 929 917 905 3316 3220 3126 3034 2944 09-3 88-0 06-0 85-6 84-3 2855 2768 2682 2598 2516 83:1 81:9 80:7 79:5 70:2 2436 2356 2279 2203 2129 2057 1986 1916 77 0 75 8 74 6 73 3 72 1 70 9 69 7 60 5 of the said excavation. Then, $(1100 \times 23) + (26640 \times 1\frac{1}{3}) = 25300 + 39960$ To find the AREA OF THE SLOPES of 27 (3731 3628 3527 3428 3330 94:1 92:9 91:7 90:5 89:3 2362 2284 2207 2132 2059 1987 1917 1849 75 8 74 6 73 3 72 1 70 9 69 7 68 5 67 2 1782 28 27 =65260 cubic yards, the total content required. Cuttings and Embankments. 26 3647 3145 3445 3346 3250 1717 1837 ---- 26 3154 3060 868 856 2290 2213 2137 2063 1991 74:6 73:3 72:1 70:9 69:7 1920 1050 1783 Multiply the contents of Column a by the Formulæ from which the Tai ble is following figures, which will give the super-ficial yards in both sides. culculated. 1633 1499 177 24 25 25 3565 3464 3364 3267 3170 3076 2983 2892 2802 2714 85:6 84:3 83:1 81:9 00:7 2220 2144 2069 1996 1924 185# 1785 1718 72:3 70:1 70:9 697 68:5 672 68:8 64:8 Let a=the number of feet which shows the greater height at the bottom of the table; b=the number of fe et which shows the less hei; ght in the left hand vertical column. Slones ‡ to 1 1591 1529 1468 1408 - 23 24 2999 2907 2817 2728 2641 84:3 83:1 81:9 80:7 79:5 1789 1722 1656 66:0 64:8 63:6 2555 2471 2389 2308 2229 78:2 77:0 75:8 74:6 73:3 2152 2076 2002 1930 1859 72:1 70:9 68:7 68:5 67:2 " 6·708 " 7·500 1409 1350 1293 587 575 562 22 23 to 1 1531 1469 1727 1660 1595 64:8 63:6 62:3 8:485 1 to 1 9:600 22 | 3328 3229 3132 3037 2943 08:0 86:8 85:6 84:3 03:1 1472 1411 1352 1294 1238 1183 22 Then, First content 2651 2761 81:9 80:7 2671 2585 2499 79:5 78:2 77:0 2415 2333 2252 2173 2095 2020 1946 1873 1802 1733 697 685 672 660 618 1665 1599 1535 63.6 62.3 61.1 ,, 10.818 $=\frac{22}{47}[(a+b)^2-ab]$ 1415 1355 1296 1239 1184 1130 1073 _____21 12·100 13·416 21 3252 3154 3058 2963 2871 86-8 85-6 84-3 83-1 81-9 2779 2690 2602 2515 2431 807 795 78:2 77:0 75:8 2 to 1 21 10 1 Second | content, 1243 1186 1132 1079 1028 078 550 538 526 513 501 489 19 20 16:155 $[a+b^{t}].$ 20 | 3178 3081 2986 2092 2800 18:974 1190 1135 1031 1029 979 930 802 538 526 513 501 489 477 464 18 1306 1248 2217 2137 2059 1982 1908 72:1 70:9 69:7 68:5 67:3 To find the Multiplier for any other Slope. Rule.—Square the given slope, add 1, and extract the square root; which root multiply by 6, and the product is the required 1254 1196 1110 1085 1032 981 931 883 837 792 596 513 501 489 477 464 452 440 17 18 | 3034 2939 2845 2753 2663 83·1 81·9 80·7 79·5 78·2 1437 1375 1313 1091 1037 985 935 806 038 793 749 706 51-3 50-1 48-9 47-7 46-4 45-2 44-0 42-8 41-6 16 17 | 2965 2871 2778 2686 2597 2509 2422 2338 2255 2173 75'8 74'6 73'3 72'1 70'9 1384 1322 1262 1203 1146 795 750 707 666 626 44-0 42-8 41-6 40-3 39-1 998 946 896 847 799 754 710 667 627 588 550 48:9 47.7 46:4 45:2 44:0 42:0 41:6 40:3 39:1 37:9 36.7 -15 15 | 2832 2739 2647 2558 2470 79.5 78.2 77.0 75.8 74.6 2383 2299 2216 2134 205-73:3 72:1 70:9 69:7 68:5 1976 1899 1824 1751 1679 67-2 66:9 64:8 63:6 62:3 1609 1541 1474 1409 1345 61:1 59:9 58:7 57:5 56:2 714 671 629 509 551 514 479 41:6 40:3 39:1 37:9 36:7 35:4 34:2. 954 903 853 805 759 47:7 46:4 45:2 44:0 42:8 2675 2585 2496 2409 770 758 746 733 1557 1490 1424 1359 1296 599 587 57:5 56:2 55:0 676 633 592 353 516 480 446 413 12 13 912 861 812 765 720 464 452 440 428 416 2436 2349 73·3 72·1 2264 2181 2100 2020 1946 70:9 69:7 68:5 67:2 66:0 382 352 773 727 682 42.8 41.6 40.3 97 557 519 482 447 414 59 367 354 342 339 318 12 | 2643 2553 2464 2377 2291 75:8 74:6 73:3 72:1 70:9 2207 2125 2044 1965 1888 697 685 672 660 648 353 \$24 296 29·3 28·1 26·9 2152 2070 1991 1912 1830 60:5 67:2 66:0 64:8 63:6 2437 2350 2264 2180 72:1 70:0 69:7 68:5 299 271 245 269 25.7 24.4 359 328 29:3 28:1 2382 2295 70·9 69·7 199 177 156 22-0 20-0 19-6 7 178 [157 138 120 20-8 19-6 18-3 17-1 2328 2242 2158 2076 69.7 68.5 67.2 66.0 8 2415 1916 1839 1763 1689 63.6 62.3 61.1 59.9 309 279 26:9 25:7 252 226 201 24:4 23:2 22:0 2276 2191 2108 2026 68:5 67:2 66:0 64:8 480 442 407 372 340 33·0 31·0 30·6 29·3 28·1 1572 1502 1433 1366 1301 575 563 550 538 526 231 205 182 23:2 22:0 20:8 2225 2141 2059 1578 67:2 66:0 64:8 63:6 1199 1137 1078 1020 964 50:1 48:9 47.7 46:4 45:2 143 123 105 89 74 61 18:3 17:1 15:9 14:7 13:4 12:2 724 677 39:1 37:9 183 174 159 147 134 122 4 127 108 91 76 62 50 39 171 159 147 134 122 110 90 1161 1101 1042 985 930 489 477 464 452 440 193 169 147 20.8 19.6 10.3 1010 1734 59:9 58:7 177 154 133 113 95 79 64 51 19:6 18:3 17:1 15:9 14:7 13:4 12:2 11:0 227 201 22:0 20:8 1922 1844 61:1 59:9 1767 1692 1619 1547 1477 587 57:5 56:2 55:0 53.8 162 140 129 18:3 17:1 15:9 101 84 68 55 14.7 13.4 12.2 11.0 25 17 11 6 2 7·3 6·1 4·9 3·7 2·4 20 13 7 3 t 0 6·1 4·9 3·7 2·4 1·2 0·0 90 74 60 46 13:4 12:2 11:0 9:8 343 310 200 250 222 196 172 257 244 232 220 208 196 183 530 490 451 415 377 31·0 30·6 29·3 28·1 26·9 1 } 2079 1997 1917 1839 1762 G1:1 59:9 58:7 57:5 1608 1614 1542 1472 1404 56:2 55:0 53:0 52:6 51:3 1337 1272 1208 1146 1086 759 710 662 37:9 36:7 35:4 617 573 312 330 138 117 99 82 66 52 40 12-2 11-0 9-8 8-6 183 160 183 17:1 1650 1578 1507 1437 1370 550 53:0 52:6 51:3 50:1 1956 1877 1800 1724 59:9 58:7 57:5 56:2 1304 1239 1177 1116 1056 5 4 3 2 1 0 8 7 6 13 12 11 10 9 15 14 30 29 28 27 26 20 19 18 17 16 50 49 48 47 46 40 39 38 37 36 35 34 33 32 31 45 44 43 42 41 LONDON: PRINTED AND PUBLISHED BY VACHER & SONS, LITHOGRAPH ERS AND PRINTERS, 29, PARLIAMENT STREET, WESTMINSTER. 2s.; Mounted in Case, 3s. 6d.

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